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Type I Progress Report  
June, 1973

# Thermal Surveillance of Active Volcanoes

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- a. Title: Thermal Surveillance of Active Volcanoes  
ERTS-A Proposal No.: SR 251
- b. GSFC ID No. of P. I. : IN 023
- c. No substantive problems are impeding the progress of the investigation.
- d. As part of ERTS-1 experiment SR 251, plans were completed early in April for a spring series of aerial thermal infrared surveys over selected volcanic sites in the northern Cascade Range, utilizing a U.S. Forest Service fire-control aircraft from Missoula, Montana. For this mission, priority was given to selected traverses over Mt. Baker, Mt. Adams, Mt. St. Helens, Mt. Hood, and Mt. Rainier.

As a result of this mission, on April 29, 1973, between 0400 and 0552 PDT, aerial infrared thermographic imagery was obtained over six northern Cascade Range volcanoes, using an RS-7 scan system. No radiation anomalies were found for Glacier Peak and Mt. Adams. The southwest slope anomaly of Mt. St. Helens in the Crums Hot Rocks area yielded a much better thermal infrared registration than previous flights, as a result of carefully selected flight altitudes and V/H settings. However, the Boot Ridge thermal area does not show, owing to snow cover. Several small, previously unknown, point-source radiation anomalies were detected in the extensive steam fields on Mt. Hood and Mt. Baker which, otherwise, were registered as on earlier infrared thermographic imagery. The summit crater anomalies of Mt. Rainier appear as on earlier imagery, but with better spatial resolution. The warmest areas appear to be the inside northwest rim of the East Crater, the outside northwest rim of the West Crater, and the outside southwest slope of the West Crater. The most outstanding result of the April 29th

survey flights, however, was the detection of approximately 48 previously unrecorded pinpoint radiation anomalies around the main cone and on the flanks of Mt. Rainier between 10,000 and 13,000 feet elevation, in outcrop areas of andesite of Mount Rainier volcano (Fiske and others, 1963, USGS Prof. Paper 444, Plate 1). These anomalies are nearly all point sources with no dimension, appearing warmer than surrounding bedrock, but not as warm as the summit anomalies. They were registered on more than one overpass. They cannot be attributed to geothermal emission without a field check, though they are located on slopes and rock walls difficult of access. On May 13th, David Frank was able to reach the ground location of one of these anomalies (A<sub>1</sub>, on our map compilation) at Disappointment Cleaver and found 27 m<sup>2</sup> of warm ground at that location. There, he measured vapor temperatures of 58°C at two vent openings, using PRT-10 radiometer and thermometer. Adjacent ground surface temperatures were 18-30°C, and, at 50 cm depth, 54°C.

See also Section k for installation of Data Communication Platform (DCP) set #6166 at Mt. St. Helens, Washington.

e. There are three significant scientific results of the discovery of the above-mentioned (Section d) 48 pinpoint anomalies on the upper flanks of Mt. Rainier. (1) Many of these points may actually be the location of fumarolic vapor emission or warm ground considerably below the summit crater, (2) Discovery of these small anomalies required specific V/H scanner settings for precise elevations on Mt. Rainier's flank, to avoid smearing the anomalies to the point of nonrecognition. Several past missions flown to map the thermal anomalies of the summit area did not

detect the flank anomalies; (3) this illustrates the value of the aerial IR scanner as a geophysical tool suited to specific problem-oriented missions, in contrast to its more general value in a regional or reconnaissance anomaly-mapping role.

f. Friedman, J. D., Frank, D. G., Preble, Duane, and Painter, J. E., 1973, Thermal Surveillance of Cascade Range Volcanoes Using ERTS-1 Multispectral Scanner, Aircraft Imaging Systems, and Ground-Based Data Communications Platforms, in Symp. on Significant Results Obtained from the Earth Resources Technology Satellite-1: NASA SP-327, v. 1, p. 1549-1560.

g. none

h. none

i. same as previous submission

j. none

k. On May 17th, DCP set #6166 was finally installed successfully by a field team headed by David Frank in a thermal area 1,000 feet southwest of and below the summit of Mt. St. Helens and has been transmitting temperature data successfully since then. The installation required a helicopter sling maneuver from a hovering position on Mt. St. Helens' steep southwest side slope. Set #6020 has been transmitting from Bumpass Hell geothermal area in Lassen Volcanic National Park., set #6104 from Devil's Kitchen in that park, and set #6251 from a location near the summit of Mt. Baker, Washington.